

FUNCTIONAL ROLE OF STARCH AND κ -CARRAGEENAN ON THE RHEOLOGY AND FLAVOUR OF A CUSTARD DESSERT (COST 921 RECIPE)

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INTRODUCTION

Flavour release and perception are complex processes in which different physico-chemical and physiological phenomena may be involved ¹. Whereas flavour release is mainly governed by chemical and/or physical interactions between flavour compounds and the food matrix ², perception is strongly influenced by physiological factors like mouth volume, saliva flow rate and air flow rate through the mouth and nose ³. In the framework of COST 921 action, the main objective of this work was to study the influence of composition on the rheology and on the intensity of sweetness and strawberry aroma of some custard model systems with reference to the COST 921 formulation.

SAMPLE PREPARATION

Four custard samples were prepared: the Model Custard Standard Recipe (starch, 4% w/w and κ -carrageenan, 0.01% w/w) and three samples varying in the concentration of modified tapioca starch E 1442 (C* Creamtex 75720. Cerestar Ibérica, Spain) (3 or 4% w/w as corrected for moisture content) and including κ -carrageenan (MeyproTM Lact HMF, Gelymar) or not. Starch moisture content was determined with a LJ16 moisture analyzer (Mettler Toledo GmbH, Switzerland). All formulations also included fixed amounts of sugar (5% w/w), strawberry flavour (0.06% w/w) (Givaudan Schweiz AG) and rehydrated full fat milk (90% w/w). Milk (3.5% fat) was prepared 24h in advance by dissolving milk powder in deionised water.

Samples were prepared following the procedure proposed by Nuessli and Conde-Petit (COST 921 Model Custard Standard Recipe): κ -carrageenan, starch and sugar were mixed in a flask and milk was added at a temperature of 25°C. The total mixture was placed during 30 minutes inside a water bath at a temperature of 98° C and stirred constantly with a mechanical stirrer at 207 rpm approximately. After the heating process sample was cooled down and aroma was added when the sample reached 40 °C. Evaporated water was then replaced.

Finally samples were kept 24h in refrigerator at $4\pm 1^\circ\text{C}$ prior to sensory and rheological tests.

RHEOLOGICAL MEASUREMENTS

Measurements were carried out in a controlled stress rheometer RS1 (Thermo Haake, Germany) (Figure 1), using a parallel plates geometry of 6 cm diameter and 1mm gap, and monitored with RheoWin Job software package (Version 2.93, Haake). A temperature of $10 \pm 1^\circ\text{C}$ was kept during measurements. Samples were allowed to rest for 15 minutes before being measured and a fresh sample was loaded for each measurement.

Flow behaviour. Up and downward curves were recorded. Samples flow was measured by recording shear stress at increasing shear rates from 0 to 100 s^{-1} through 60 s and down in reverse sequence in the same time.

Mechanical spectra. In order to determine the linear viscoelastic region, stress sweeps were run at 1 Hz. The frequency sweeps were performed over the range $f = 0.1\text{-}10 \text{ rad/s}$ and the values of G' , G'' , $\tan \delta$ and η^* , as a function of frequency, were calculated using the Rheowin Job software (Version 2.93, Haake).

SENSORY ANALYSIS

Sensory analysis was held in a standardised test room with separate booths (UNE 87004:1979) (Figure 2). A group of 40 selected assessors evaluated the samples according to their sweetness intensity and to their strawberry aroma intensity by ranking tests. Data acquisition and analysis was performed using Compusense Five V. 4.6 software (Compusense Inc., Canada). The four samples (30 ml), codified with three

random numbers, were presented simultaneously. Friedman Analysis of Variance was applied to the sensory data and significance of the differences between samples were determined by the Fisher test ($\alpha=0.05$).

RESULTS AND DISCUSSION

Rheological measurements. All samples exhibited shear thinning and time dependence behaviour (Figure 3). At the two starch concentrations studied, the removal of κ -carrageenan decreased the thixotropic area and the consistency. Decrease of starch concentration also reduced both parameters.

Samples with the higher starch concentration showed a gel-like behaviour (Figure 4a), whereas the mechanical spectra of 3% starch samples revealed a weaker structure (Figure 4b). Reducing the percentage of starch from 4 to 3% lead to lower values of G' and G'' (Figures 4a and 4b). The removal of κ -carrageenan decreased the G' and G'' values at the two levels of starch, although this decrease was small at low frequencies for the 3% starch samples.

Except for the Model Custard Standard Recipe, the rest of the mechanical spectra were slightly dependent on frequency.

Sensory analysis. Analysis of results obtained from the ranking tests showed significant differences ($\alpha=0.05$) in both sweetness and strawberry aroma intensity. Only the sample at 3% starch level without κ -carrageenan was ranked significantly as sweeter and with more strawberry aroma than the rest of the samples (Figure 5).

CONCLUSIONS

The variation of the starch concentration and the removal of κ -carrageenan clearly modified the rheological behaviour of the studied systems. However, when analyzing sensory data a different trend was observed: on one hand, the effect of the starch concentration on the perception of both attributes was only significant when no κ -carrageenan was present. On the other hand, κ -carrageenan only affected sweetness and strawberry aroma perception at the 3% starch level.

ACKNOWLEDGEMENTS

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Figure 1. Haake RS1 Rheometer



Figure 2. Booth and standardised test room

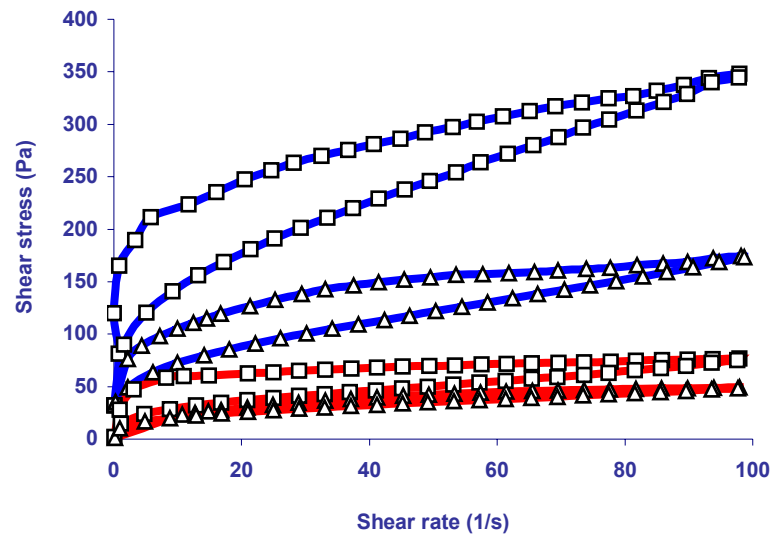


Figure 3. Rheograms of samples containing κ -carrageenan (\square) and without it (\triangle) at 3% (—) and 4% starch level (—).

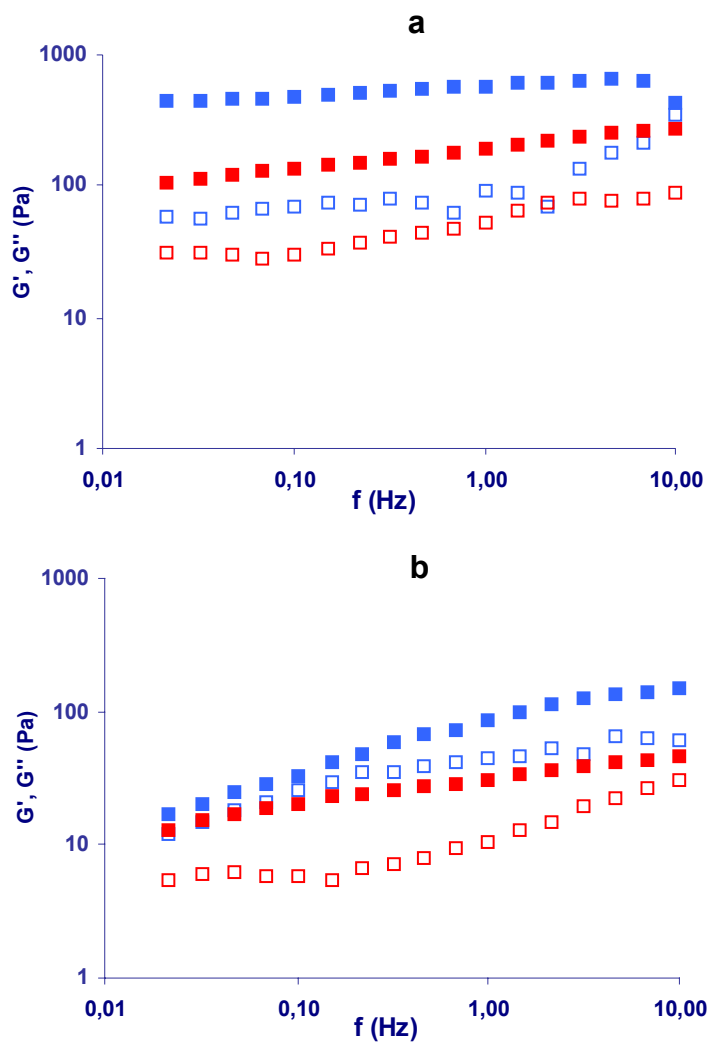


Figure 4. Frequency sweeps of 4% starch (a) and 3% starch samples (b). Values of G' (filled symbols) and G'' (empty symbols) for samples with κ -carrageenan (■) and without it (□).

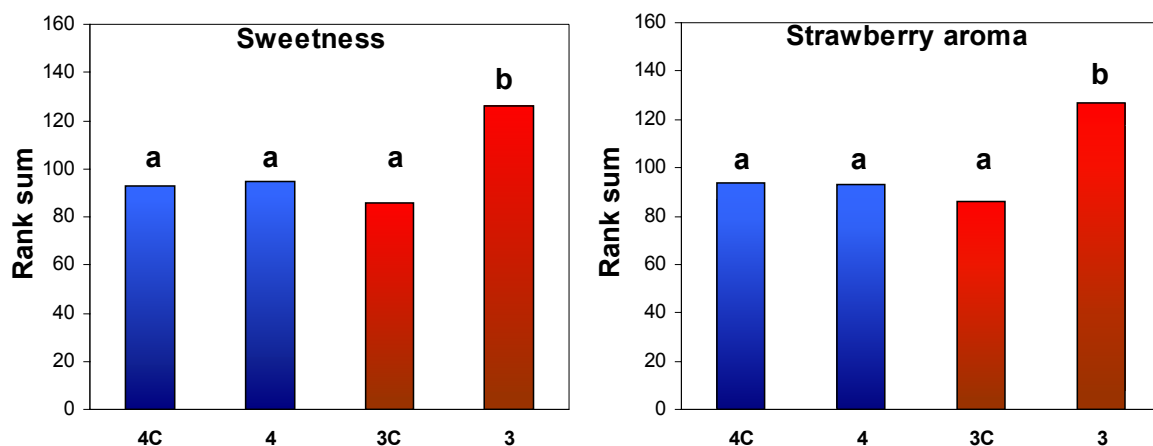


Figure 5. Sweetness intensity and strawberry aroma intensity of custard samples: 4% starch with κ -carrageenan (4C), 4% starch (4), 3% starch with κ -carrageenan (3C) and 3% starch (3). Different letters on top of bars mean significant differences ($\alpha=0.05$).

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COST ACTION 921 WORKSHOP

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